Final Examination of Pre-university Physics

Name_____ I.D. NO._____ **(**Time: 2 hours)

PART I: Single-Choice Questions (84')

REQUIEMENTS: (1) Please use fountain PEN or signing PEN only.

(2) Please fill in the correct answers in brackets.

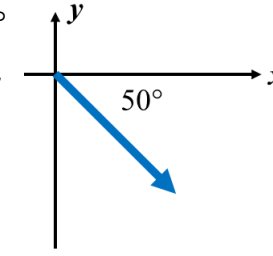
1. How many basic units does the SI system have? **( )**

   (A) three (B) four (C) five (D) seven

2. A vector $\vec{A}$ has components Ax = 12 m and Ay = 5.0 m. What is the magnitude of vector $\vec{A}$? **( )**

   (A) 7.0 m (B) 13 m (C) 17 m (D) 60 m

3. Vector $\vec{A}$ has a magnitude 5.00 and points in a direction 50.0 ° counterclockwise from the positive x axis. What are the x and y components of vector $\vec{A}$. **( )**



   (A) Ax = 0.643 and Ay = 0.766 (B) Ax = –3.83 and Ay = –3.21

   (C) Ax = 3.21 and Ay = 3.83 (D) Ax = 3.83 and Ay = 3.21

4. An airplane that is flying level needs to accelerate from a speed of 200 m/s to a speed of 240 m/s while it flies a distance of 1200 m. What must the acceleration of the plane be? **( )**

   (A) 4.44 m/s^2 (B) 2.45 m/s^2 (C) 7.33 m/s^2 (D) 5.78 m/s^2

5. If an object was freely falling, from what height would it need to be dropped to reach a speed of 70.0 m/s before reaching the ground? **( )**

   (A) 250 m (B) 322 m (C) 489 m (D) 500 m

6. An object is moving with constant velocity in a straight line. Which of the following statements is true? **( )**

   (A) A constant force is being applied in the direction of motion.

   (B) A constant force is being applied in the direction opposite of motion.

   (C) The net force on the object is zero.

   (D) There is no frictional force acting on the object.

7. Two cars collide head-on. At every moment during the collision, the magnitude of the force the first car exerts on the second is exactly equal to the magnitude of the force the second car exerts on the first. This is an example of **( ).**

   (A) Newton's first law. (B) Newton's second law.

   (C) Newton's third law. (D) Newton's law of gravitation.

8. A 1200-kg car starts from rest and accelerates with constant acceleration, traveling 200 m in 9.00 s. What is the force of the road on the car during this acceleration? **( )**

   (A) 1.43 kN (B) 3.87 kN (C) 5.93 kN (D) 7.82 kN

9. When an object experiences uniform circular motion, the direction of the acceleration is **( )**.

   (A) in the same direction as the velocity vector.

   (B) in the opposite direction of the velocity vector.

   (C) is directed toward the center of the circular path.

   (D) is directed away from the center of the circular path.

10. A constant horizontal force of 20 N is applied to an object of mass 8.0 kg. What is the work done by this force on the object if it causes a displacement of 2.0 m along the horizontal direction? **( )**

    (A) 40 J (B) 0 J (C) 36 J (D) 17 J

11. A 20-kg object is resting at the top of a table 1.6 m above ground level. The object is then picked up and moved to a height of 8.7 m above ground level. What is the change in the gravitational potential energy of this object? Use $g = 10\ m/s^2$. **( )**

    (A) 140 J (B) 1740 J (C) 320 J (D) 1420 J

12. Neglecting air resistance, when you toss a stone straight up in the air from Earth's surface, which of the following statements is true for the upward motion of the stone. **( )**

    (A) The stone's kinetic and gravitational potential energies increase simultaneously.

    (B) The stone's kinetic and gravitational potential energies decrease simultaneously.

    (C) The stone's kinetic energy decreases while its gravitational potential energy increases.

    (D) The stone's kinetic energy increases while its gravitational potential energy decreases.

13. An inelastic collision of two objects is characterized by the following. **( )**
    (A) Total momentum of the system is conserved.
    (B) Total mechanical energy of the system remains constant.
    (C) Total kinetic energy of the system remains constant.
    (D) Only A and B are true.

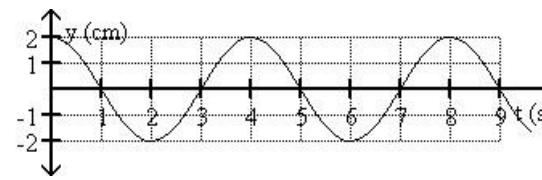
14. At what speed must a 150-kg football player be moving to have the same momentum as a 15.0-kg bullet traveling at 300 m/s? **( )**
    (A) 10.0 m/s (B) 3.00 m/s (C) 30.0 m/s (D) 1.00 m/s

15. A red ball with a velocity of +3.0 m/s collides head-on with a yellow ball of equal mass moving with a velocity of –2.0 m/s. If the yellow ball moves with a velocity of +0.5 m/s, what is the velocity of the red ball after the collision? **( )**
    (A) –2.0 m/s (B) +3.0 m/s (C) +0.5 m/s (D) +5.0 m/s

16. A 0.250-kg rubber ball is dropped from a height of 2.00 m. It hits the floor with speed 20.0 m/s and rebounds with speed 6.00 m/s. What is the magnitude of impulse the floor applies to the ball? **( )**
    (A) 2.00 N·s (B) 3.50 N·s (C) 5.00 N·s (D) 6.50 N·s

17. What is the length of a simple pendulum with a period of 2.00 s? **( )**
    (A) 19.6 m (B) 0.994 m (C) 1.22 m (D) 1.62 m

18. Right figure shows the displacement of a wave at a given position as a function of time and the displacement of the same wave at a given time as a function of position. Determine the frequency of the wave. **( )**
    (A) 4.0 Hz
    (B) 3.0 Hz
    (C) 0.5 Hz
    (D) 0.25 Hz



19. A mass of 0.250 kg is attached to a spring and undergoes simple harmonic oscillations with a period of 0.640 s. What is the force constant of the spring? **( )**
    (A) 2.45 N/m (B) 12.1 N/m (C) 24.1 N/m (D) 0.102 N/m

20. If an atom has become a positive ion, it has **( )**.

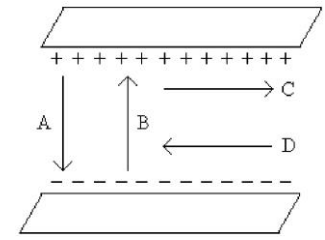
(A) gained an electron or electrons (B) lost an electron or electrons.

(C) gained a proton or protons. (D) lost a proton or protons.

21. A negatively charged rod is brought near one end of an uncharged metal bar. The end of the metal bar farthest from the charged rod will be charged **( )**.

(A) positive. (B) negative. (C) neutral. (D) none of the given answers

22. Which of the arrows shown in the right figure represents the correct direction of the electric field between the two metal plates? **( )**



(A) A

(B) B

(C) C

(D) D

23. Two point charges, initially 2.0 cm apart, experience a 1.0-N force. If they are moved to a new separation of 8.0 cm, what is the electric force between them? **( )**

(A) 4.0 N (B) 16 N (C) 1/4 N (D) 1/16 N

24. A +8.00-μC charge is situated along the +*y*-axis at *y* = 0.400 m. What is the electric potential at the origin because of this charge? **( )**

(A) $+180 \times 10^3$ V (B) -180×10^3 V (C) -288×10^3 V (D) $+288 \times 10^3$ V

25. Consider two copper wires. One has twice the cross-sectional area of the other. How do the resistances of these two wires compare? **( )**

(A) Both wires have the same resistance.

(B) The thicker wire has half the resistance of the shorter wire.

(C) The thicker wire has twice the resistance of the shorter wire.

(D) none of the given answers

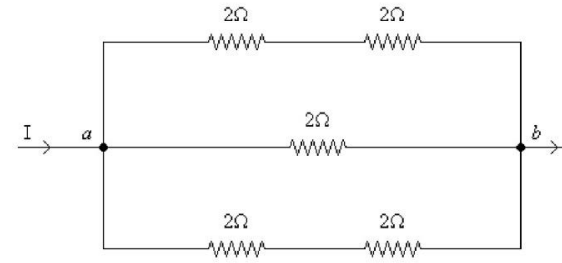
26. A light bulb operating at 110 V draws 1.40 A of current. What is its resistance? **( )**

(A) 12.7 Ω (B) 78.6 Ω (C) 109 Ω (D) 154 Ω

27. A 110-V hair dryer is rated at 1200 W. What current will it draw? **( )**

(A) 0.090 A (B) 1.0 A (C) 5.0 A (D) 11 A

28. Five equal resistors, of value 2.0 Ω each, are connected as shown in right figure. What is the equivalent resistance of this circuit? **( )**



(A) 1.0 Ω (B) 3.0 Ω

(C) 6.0 Ω (D) 9.0 Ω

29. A current carrying circular loop of wire lies flat on a table top. When viewed from above, the current moves around the loop in a counterclockwise sense. What is the direction of the magnetic field caused by this current, inside the loop? The magnetic field **( )**.

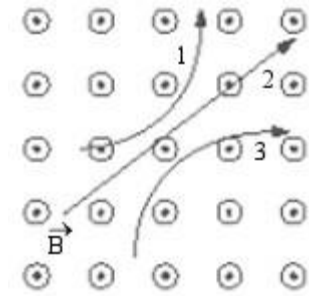
(A) circles the loop in a clockwise direction.

(B) circles the loop in a counterclockwise direction.

(C) points straight up.

(D) points straight down.

30. Three particles travel through a region of space where the magnetic field is out of the page, as shown in Fig. 1-4. The electric charge of each of the three particles is, respectively, **( )**.



(A) 1 is positive, 2 is neutral, and 3 is negative.

(B) 1 is negative, 2 is neutral, and 3 is positive.

(C) 1 is positive, 2 is neutral, and 3 is positive.

(D) 1 is negative, 2 is neutral, and 3 is negative.

31. A proton is projected with a velocity of 7.0×10^3 m/s into a magnetic field of 0.60 T perpendicular to the motion of the proton. What is the force that acts on the proton? **( )**

(A) 3.4×10^{-16} N (B) 4.2×10^{-16} N (C) 13×10^{-16} N (D) 6.7×10^{-16} N

32. A circular loop of wire is in the plane of the paper. The north pole of a bar magnet is being moved toward the center of the loop from a position in front of the paper. The direction of the induced current in the loop **( )**.

(A) is clockwise. (B) is south. (C) is counterclockwise. (D) is north.

33. A transformer changes the 10000 V power line to 120 V. If the primary coil contains 750 turns, how many turns are on the secondary? **( )**

(A) 3 (B) 9 (C) 6.3×10^4 (D) 2.1×10^4

34. An airplane is flying horizontally in a region where the earth's magnetic field is 5.2×10^{-5} T downward. If the speed of the plane is 200 m/s and the wing tips are 65 m apart, what is the potential difference between the wing tips? **( )**

(A) 1.0×10^{-5} V (B) 0.34 V (C) 0.68 V (D) 1.0×10^{-2} V

35. A laser beam strikes a plane's reflecting surface with an angle of incidence of 43 °. What is the angle between the incident ray and the reflected ray? **( )**

(A) 43 ° (B) 86 ° (C) 45 ° (D) 90 °

36. An object is 12 cm in front of a concave mirror, and the image is 3.0 cm in front of the mirror. What is the focal length of the mirror? **( )**

(A) 0.25 cm (B) 15 cm (C) 4.0 cm (D) 2.4 cm

37. A light ray in air enters water at an angle of incidence of 40 °. Water has an index of refraction of 1.33. The angle of refraction in the water is **( )**.

(A) 59 ° (B) 29 ° (C) 40 ° (D) 1.33 °.

38. If a person's eyeball is too short from front to back, the person is likely to suffer from **( )**.

(A) astigmatism. (B) spherical aberration. (C) farsightedness. (D) nearsightedness.

39. The energy of a photon depends on **( )**.

(A) its amplitude. (B) its velocity. (C) its frequency. (D) its mass.

40. In order for a photon to eject an electron from a metal's surface in the photoelectric effect, the photon's **( )**.

(A) frequency must be greater than a certain minimum value.

(B) speed must be greater than a certain minimum value.

(C) wavelength must be greater than a certain minimum value.

(D) momentum must be zero.

41. An element with atomic number 88 goes through alpha decay. Its atomic number is now **( )**.

(A) 82. (B) 84. (C) 86. (D) 88.

42. Rutherfordium-261 has a half-life of 1.08 min. How long will it take for a sample of rutherfordium to lose one-third of its nuclei? **( )**

(A) 0.63 min (B) 1.62 min (C) 2.70 min (D) 3.24 min

PART II: Calculations (16')

Please Only choose One of following questions to answer.

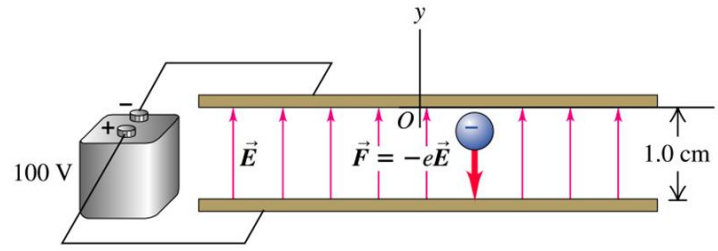
1. Suppose the direction of $\vec{E}$ is vertically upward, as shown by the vectors in Figure.

   (a) If an electron is released from rest at the upper plate, what is its acceleration?

   (b) What speed does it acquire while traveling 1.0 cm to the lower plate?

   (c) How much time is required for it to travel this distance?

   [An electron has a charge $-e = -1.60 \times 10^{-19}$ C and a mass $m = 9.11 \times 10^{-31}$ kg]



2. An object 8 cm high is placed 12 cm to the left of the converging lens of focal length 8 cm. A second converging lens of focal length 6 cm is placed 36 cm to the right of the of the first lens. Both lens have the same optic axis. Find the image of the object on the following graph. Find the position, size and orientation of the image produced by the 2 lens in combination. (F_1 and F_2 are focal points of the left lens, F_1' and F_2' are focal points of the right lens)